

## A new species of *Enhydrosoma* Boeck, 1872 (Copepoda: Harpacticoida: Cletodidae) from the Eastern Tropical Pacific

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**Abstract.**—Some enhydrosomids were found while sorting samples taken from the Urías system during a short-term study on the effects of organic enrichment on the abundance and diversity of benthic copepods. Upon careful examination, these specimens proved to belong to a new species, *Enhydrosoma brevipodum*, of the species-group defined by the lack of sexual dimorphism on the male P3 and can be separated by the reduced exopod of female P5. *Enhydrosoma brevipodum*, whose full description is herein provided, constitutes the fourth record of the genus from the Pacific Mexican coast.

The genus *Enhydrosoma* Boeck, 1872 is a group of harpacticoid copepods commonly found in shallow brackish and marine coastal systems worldwide. Some *Enhydrosoma* specimens were found in sediment samples from two shallow brackish systems in central (Ensenada del Pabellón lagoon) and southern (Urías system) Sinaloa during the course of two short-term studies about the effects of organic enrichment on the distribution and abundance of meiofauna (see Gómez-Noguera & Hendrickx 1997) and on the diversity of benthic harpacticoids. Some of these specimens belong to three species recently described by Gómez (2003), whereas some specimens constitute the Pacific counterpart of *Enhydrosoma lacunae* Jakubisiak, 1933 (Gómez 2003), originally described from Cuba and redescribed by Fiers (1996) from the Yucatan Peninsula. While sorting samples taken from Urías system, some specimens of a different species of *Enhydrosoma* were found. These specimens proved to belong to a new species mainly characterized by the reduced exopod of female P5. A detailed description of this species is herein provided.

### Materials and Methods

Quantitative sediment cores were taken for the analysis of the effects of organic enrichment on benthic copepods along a polluted estuary (Urías system) in southern Sinaloa (north-western Mexico) during 2001 and 2002. Sediment samples were taken with an Eckman box corer with a sampling area of 225 cm<sup>2</sup>, and subsamples were taken using plastic corers with a sampling surface of 7 cm<sup>2</sup>. Sediment cores were subdivided vertically into separate 1 cm slices to a depth of 5 cm. Each slice was fixed with 10% formalin, and sieved through 500 and 63 µm sieves to separate macro- and meiofauna. Meiofauna was preserved in 70% ethanol and stained with Bengal Rose until further inspection. Meiofaunal major taxa were quantified and copepods (cyclopoids, poecilostomatoids and harpacticoids) were separated from the rest of meiofauna and stored in 70% ethanol for further investigation. Observation and drawings of the species described herein were made from whole and dissected specimens mounted in lactophenol, under 100× oil immersion objective using a Leica compound microscope equipped with drawing

tube and phase contrast. The type material was deposited in the collection of the Instituto de Ciencias del Mar y Limnología, Mazatlán Marine Station. The terminology proposed by Huys & Boxshall (1991) for the general description and armature formulae was adopted. Abbreviations used in the text and tables: P1–P6, first to sixth swimming leg; EXP, exopod; ENP, endopod.

Family Cletodidae T. Scott, 1904 sensu  
Por (1986)

Genus *Enhydrosoma* Boeck, 1872

*Enhydrosoma brevipodum*, new species

*Type material*.—One female holotype preserved in 70% ethanol (EMUCOP-090301-73), one dissected male allotype (EMUCOP-090301-62), and one dissected female paratype (EMUCOP-090301-61); collected from station 10; 9 Mar 2001; leg. S. Gómez.

*Type locality*.—Urías system, Sinaloa, northwestern Mexico (23°09'–23°13'N, 106°20'–106°25'W).

*Etymology*.—The specific name alludes to the reduced exopodal lobe of female P5.

*Female*.—Body (Fig. 1A, 2A) tapering from posterior margin of cephalothorax, curved in lateral view; length of holotype, 420  $\mu\text{m}$  from tip of rostrum to posterior margin of caudal rami. Cephalic shield about  $\frac{1}{4}$  total length, with strongly folded lateral and dorsal surface, posterior margin plain, with sensilla arising from distinct cones. Rostrum triangular, fused to cephalic shield, with rounded tip, with two sensilla. Dorsal surface of free thoracic somites (P2–P4) smooth, with sensilla arising from distinct cones along plain posterior margin. First urosomite (P5-bearing somite) as preceding somites except for fewer sensilla. Surface of genital double somite smooth, with dorsolateral division between first and second genital somite (second and third urosomites), posterior margin of both genital somites plain, first somite with sensilla arising from distinct cones along posterior

margin, second somite as first one except for two additional tube pores (arrowed in Fig. 1A), both somites with additional sensilla arising from paired bulbous structures laterally; genital somites completely fused ventrally, first somite bearing pair of P6 and genital pore, the former each bearing a short spinulose spine, and with an associated tube-pore (arrowed in Fig. 2A), copulatory pore covered by integumental fold, ventral surface of second segment smooth, except for spinules and fragile setules along posterior margin between pair of sensillum-bearing cones. Dorsal surface of fourth and fifth urosomite as in preceding somite, except for lack of central pair of sensilla on posterior margin of fourth somite, and lack of sensilla along posterior margin of fifth urosomite, both somites with pair of tube pores (arrowed in Fig. 1A); ventral surface of fourth and fifth urosomite smooth, fourth urosomite ornamented with spinules and setules as in second genital somite, fifth urosomite with only spinules along posterior margin. Anal segment smooth, rounded anal operculum without ornamentation and flanked by pair of sensilla. Caudal rami cylindrical and about 8.3 times as long as wide, with seven setae in all, setae I and II located in proximal fifth, the former arising ventrally and about  $\frac{1}{2}$  total length of seta II, the latter dorsal to seta I, seta III slightly longer than seta II and arising in the middle along outer margin of ramus, seta IV and V fused, seta VI located in distal inner corner and as long as seta II, seta VII arising in proximal third at the level between seta II and III.

Antennule (Fig. 2B). 5-segmented; surface of segments smooth except for spinular row on first, third and fourth segment. Armature formula 1-(1), 2-(7), 3-(7+ae), 4-(1), 5-(11+ae).

Antenna (Fig. 3A, B) with proximal and distal set of spinules on inner margin of allobasis; with very small distal abexopodal seta close to distal set of spinules, the latter difficult to see and can be easily mistaken for a setule (arrowed in Fig. 3A). Exopod

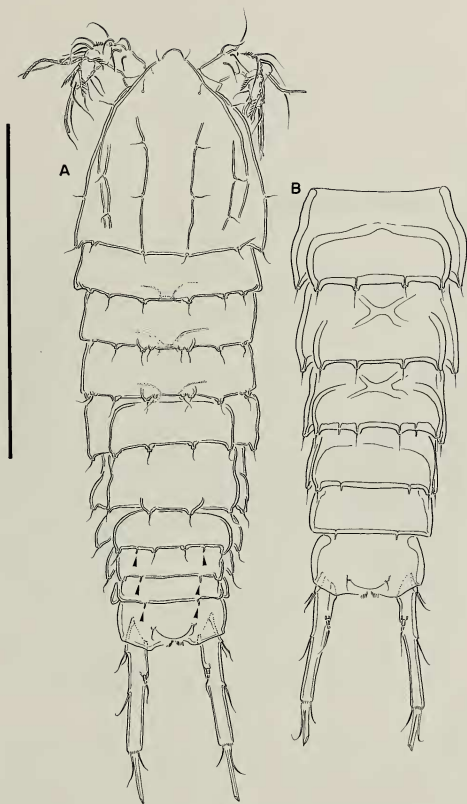


Fig. 1. *Enhydrosoma brevipodum*, new species. A, female, habitus, dorsal; B, male, urosome, dorsal. Scale bar: A, 200  $\mu\text{m}$ ; B, 160  $\mu\text{m}$ . A, paratype EMUCOP-090301-61; B, allotype EMUCOP-090301-62.



Fig. 2. *Enhydrosoma brevipodum*, female paratype EMUCOP-090301-61. A, urosome, ventral (P5 bearing-somite omitted; tube pores in genital field arrowed); B, antennule. Scale bar: A, 100  $\mu\text{m}$ ; B, 75  $\mu\text{m}$ .



Fig. 3. *Enhydrosoma brevipodum*, female paratype EMUCOP-090301-61. A, antenna with aberrant exopod; B, normal exopod of antenna; C, maxilliped; D, Pl. Scale bar, 50  $\mu$ m.

1-segmented and armed with two bipinnate elements (Fig. 3B). Endopodal segment ornamented with two strong spines subdistally along inner margin; distal margin five setae/spines (outer pectinate spine seemingly without fused small seta), and ornamented with two hyaline frills on outer margin.

Mandible (Fig. 4A, B) with slender gnathobase; biting edge with uni- and multicuspitate teeth, and one bare seta at distal

inner corner. Palp well-developed, 1-segmented and armed with one endopodal and two basal setae (Fig. 4B).

Maxillule (Fig. 4C). Arthrite with five distal and two lateral elements, and two surface setae; coxal endite fused to basis and represented by one seta, basis represented by two distal setae, endopod and exopod represented by one seta each.

Maxilla (Fig. 4D) with short spinular row

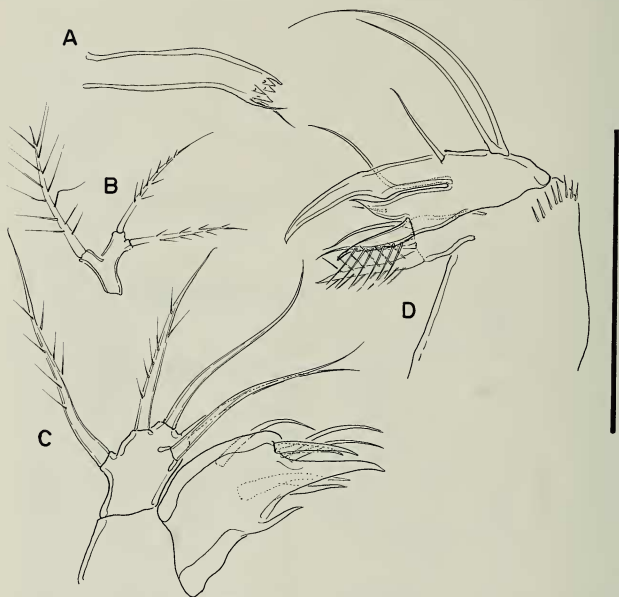


Fig. 4. *Enhydrosoma brevipodum*, female paratype EMUCOP-090301-61. A, mandible; B, mandibular palp; C, maxillule; D, maxilla. Scale bar: A, B, 50  $\mu\text{m}$ ; C, D, 25  $\mu\text{m}$ .

on distal inner corner of syncoxa; proximal syncoxal endite with two slender and bare setae and one bipinnate element; distal syncoxal endite with two elements (inner strongly pinnate, outer anvil shaped, fused to endite and with only one pinnule). Allobasal endite with non-articulated spine and two setae. Endopod represented by two setae fused at base.

Maxilliped (Fig. 3C) prehensile, with short and unarmed syncoxa; basis with spinules along inner margin; claw slender and curved distally, with accessory seta.

P1 (Fig. 3D). Coxa and basis ornamented as depicted, the latter with inner and outer setae. Exopod three-, endopod 2-segmented, the latter reaching distal third of last exopodal segment.

P2-P4 (Figs. 5A, B, 6A) with coxa and basis ornamented as shown, the latter with outer plumose seta. Exopod three-, endopod 2-segmented. Endopod of P2 slightly longer than, of P3 as long as, of P4 clearly shorter than first and second exopodal segments combined. Armature formulae of P1-P4 as follows:

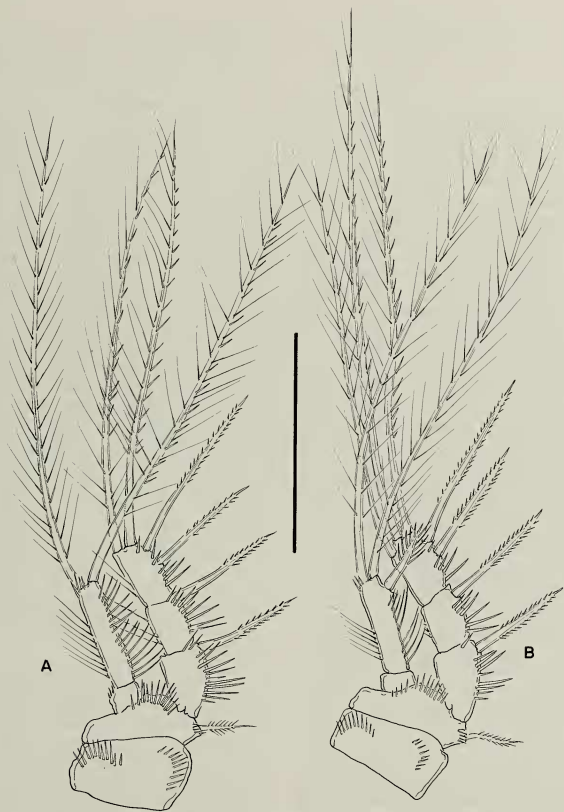


Fig. 5. *Enhydrosoma brevipodum*, female paratype EMUCOP-090301-61. A, P2; B, P3. Scale bar: 50  $\mu\text{m}$ .

	P1	P2	P3	P4
EXP	I-0;I-0;II,2,0	I-0;I-0;II,2,0	I-0;I-0;II,2,1	I-0;I-0;II,2,1
EXP	0-0;I,1,1	0-0;0,2,0	0-0;I,2,0	0-0;I,2,0

P5 (Fig. 6B). Baseoendopod and exopod fused but with partial suture still visible on posterior face. Exopod almost square, with a few setules on outer margin, three setae (one minutely pinnate) on distal margin and a large tri-pinnate seta on inner margin.

Baseoendopod with transverse rows of spinules on endopodal lobe and at base of exopod; outer seta on long pedicel. Endopodal lobe reduced with three elements (a strong inner pinnate spine and a long pinnate seta on distal margin, and a slender pinnate seta on inner margin).

*Male*.—Total body length, 450  $\mu\text{m}$ . General dorsal body shape (not shown) as in female. Urosome (Fig. 1B) as in female dorsally; second and third urosomites distinct ventrally (Fig. 7A); first urosomite without ventral spinular ornamentation along posterior margin; second urosomite with P6 represented by one fused and one free plate close to posterior margin ventrally (Fig. 7A), and ornamented with spinules along posterior margin; third to fifth urosomites with spinules and fragile setules along posterior margin; fifth urosomite without sensilla. Caudal rami (Figs. 1B, 7A), mouth parts, and P1–P4 (not shown) as in female.

Antennule (Fig. 7B) 6-segmented, subchirocer; surface of segments smooth except for short spinules of first segment and longitudinal row of long spinules on fourth globose segment. Armature formula difficult to define.

P5 (Fig. 7A). Baseoendopod and exopod fused, the former with outer extension bearing outer seta and ornamented with spinules at base of exopod and distally on endopodal lobe, the latter small and armed with one inner seta and one outer spine. Exopod elongate, about 1.5 times as long as wide, and armed with two apical setae (outermost slender and about  $\frac{1}{4}$  total length of innermost bipinnate seta).

*Remarks*.—In his outstanding preliminary revision of *Enhydrosoma*, Gee (1994) accurately stated that the armature complements of the second endopodal segment of P1 are not always reliable. This is true, as shown by Gee (1994), for *E. curticauda* Boeck, 1872, and also for *E. propinquum* (Brady, 1880) (compare Apostolov & Marinov (1988) and Sars (1909)). Also, Gee (1994) suggested that the often reduced inner seta on the P1 second endopodal segment could either be overlooked or mistakenly regarded as a spinule or setule in previous descriptions. On the other hand, it has to be noted that the males of some species (e.g., *E. intermedia* Chislenko, 1978, *E. ca-soae* Gómez, 2003 and *E. solitarium* Gómez, 2003) remain unknown and their position within *Enhydrosoma* regarding the male P3 endopod is still pending. Even when the male of a known species is found, the description of the P3 endopod is often omitted, e.g., Arlt (1983) for *E. longifurcatum* Sars, 1909 and *E. sarsi* (T. Scott, 1904); Bodin (1970) for *E. propinquum*; Apostolov & Marinov (1988) for *E. gariene* Gurney, 1930; Monchenko (1967), Apostolov & Marinov (1988) and Bodin (1970) for *E. caeni* Raibaut, 1965; Marinov & Apostolov (1985) for *E. longicauda* Marinov & Apostolov, 1983). Therefore, a thorough revision of the species currently assigned to *Enhydrosoma* is urgently needed to unravel the phylogenetic relationships within the genus.

The species herein described belongs to Gee's (1994) type 1 (being the male P3 endopod 2-segmented, with the same armature formula and form of armature elements as in the female), which seems to be rather common in *Enhydrosoma*. In fact, the unmodified condition of the male P3 endopod has been reported for 10 species—*E. migoti* Monard, 1926; *E. tunisensis* Monard, 1935 (considered as incertae sedis within *Enhydrosoma* by Wells 1965); *E. propinquum*, *E. sarsi*, *E. longifurcatum*, *E. latipes* (A. Scott, 1909); and *E. gariene*, *E. longicauda*, *E. pectinatum* Wells & Rao, 1987; *E. sor-*





Fig. 6. *Enhydrosoma brevipedum*, female paratype EMUCOP-090301-61. A, P4; B, P5. Scale bar: 50  $\mu$ m.

*didum* Monard, 1926); and *E. caeni* and *E. rosae* Fiers, 1996. Of these, only Sars' (1909) *E. propinquum*, *E. latipes*, *E. rosae* and *E. migoti* have been reported bearing three setae on the second endopodal segment of P1 (although the armature formula of the endopod of P1 needs confirming in some other species), and *E. brevipedum*

could well be most closely related to the *E. longifurcatum* species-group (*E. longifurcatum*, *E. gariene*, *E. sordidum*, *E. caeni* and *E. pectinatum*) based on the combination of the following character states: (a) the caudal ramus shape and arrangement of setae I, II, III and VII, (b) rostrum, (c) number of setae on the mandibular palp, (d) fu-



Fig. 7. *Enhydrosoma brevipedum*, male allotype EMUCOP-090301-62. A, urosome, ventral, showing P5 and P6; B, antennule. Scale bar: A, 100  $\mu$ m; B, 75  $\mu$ m.

sion of coxal endite and basis and number of setae on the whole palp, (e) number of elements on distal syncoxal endite of the maxilla, (f) lack of sexual dimorphism on P3 endopod, (g) the fusion of exopod and baseopod on P5 of both sexes, and (h) number of setae on female P6. The species described herein differs from the other species of the *E. longifurcatum* species group in the following characters: (a) presence of a seta on abexopodal margin of the first endopodal segment of the antenna, (b) number of setae on the second endopodal segment of P1 (except for Sars' (1909) *E. propinquum*), (c) proportions of P5 exopod in both sexes and arrangement of setae in female (in all other species in this group the large inner seta is on distal margin and outer setae on outer margin, but in *E. brevipedum* the large seta is located internally and the others on distal margin. In this regard it has to be noted that *E. longifurcatum* and *E. sordidum* were reported to have only three setae on P5 exopod, but it is highly probable that there are four setae, being that the middle outer element is very small and weak (J. M. Gee, in litt.). The inner and outer elements of female exopod of P5 are strong and pectinate spines in *E. longifurcatum*, *E. gariene*, *E. sordidum*, *E. caeni* and *E. pectinatum*, but it is a pinnate seta in *E. brevipedum*. On the other hand, the genital field of *E. brevipedum* is similar to that described for *E. curticauda* by Gee (1994) in that the single copulatory pore is covered by an integumental fold, but differs in the armature formula of P6 (with two and one seta in *E. curticauda* and *E. brevipedum*, respectively), spinular ornamentation (with and without spinules in *E. curticauda* and *E. brevipedum*, respectively), and number and location of tube pores (with three tubular extensions arising from two pores in *E. curticauda*, and with two tubular extensions arising from two pores in *E. brevipedum*). The genital field of *E. brevipedum* seems to be similar to that described by Gee (1994) for *E. propinquum* in the number and location of the tube pores, and similar

to that described for *Strongylacron buchholzi* (Boeck, 1872) and *E. gariene* in the armature formula and lack of spinular ornamentation of P6 (see Gee, 1994:95, figs. 9C-E). Also, according to Gee (1994) the position of spinules and/or setules on the inner margin of the antennal allobasis could be used to discern which abexopodal seta has been lost in a given species. The distal abexopodal seta observed for *E. brevipedum* is very small and can be easily mistaken for a setule. However, careful examination revealed the presence of small spinules at the base of this element which, following Gee (1994), could indicate either the site where a seta is possibly attached or the site where the abexopodal seta must have been situated in those cases where the proximal (basal) or the distal seta was lost. All the above suggests the presence of a very reduced distal seta and loss of the proximal (basal) seta in *E. brevipedum*, which is also the case for most species within *Enhydrosoma* (Gee, 1994). It is interesting to note that a female paratype of *E. brevipedum* (EMUCOP-090301-61) was found to possess an aberrant antennal exopod bearing three setae (two well-developed and one dwarfed element) (see Fig. 3A). The same has been observed for a female of *E. curticauda* from East Finnmark (Gee, 1994: 97). To the best of my knowledge, *E. brevipedum* is unique within the genus by the reduced exopod of the female P5.

*Enhydrosoma brevipedum* was found in sandy sediments taken in the mouth of the Urías brackish system. The sampling station (stn. 10) where the newly found species was taken is under the direct effects of marine water and is characterized by sandy bottom and low contents of chlorophyll "a" (3189.2 mg l<sup>-1</sup>) and organic mater (2.8%).

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